

AMENDMENTS
In the Claims

Current Status of Claims

1 **1.(withdrawn and previously presented)** An MRI coil apparatus comprising:

2 four members, each member including a superconducting layer, where the members are
3 arranged to form four overlapping regions, where each overlapping region comprises a capacitor
4 formed from overlapping portions of the superconducting layers of two of the members and an
5 overlapping region dielectric layer interposed therebetween,

6 where two of the members are straight and two of the members are curvilinear and where the
7 apparatus comprises a closed saddle-shaped coil apparatus.

1 **2.(withdrawn and previously presented)** The apparatus of claim 1, wherein each member further
2 includes a substrate dielectric layer upon which the superconducting layer was formed, where the
3 dielectric layer of the straight members comprise a rigid dielectric material and the dielectric layer
4 of the curvilinear members comprise a flexible dielectric material.

1 **3.(withdrawn and previously presented)** The apparatus of claim 2, wherein the superconducting
2 layer of the curvilinear members comprises a plurality of substantially flat superconducting
3 segments.

1 **4.(withdrawn and previously presented)** The apparatus of claim 3, wherein the overlapping
2 regions of the superconducting layer of the curvilinear member comprise portions of one of the
3 substantially flat superconducting segments.

1 **5.(withdrawn and previously presented)** The apparatus of claim 2, wherein the overlapping
2 region dielectric layers comprise separate dielectric layers distinct from the substrate dielectric
3 layers.

1 **6.(withdrawn and previously presented)** The apparatus of claim 5, wherein the substrate and the
2 overlapping region dielectric layers are composed of the same or different dielectric material.

1 **7.(canceled)**

1 **8.(pr withdrawn and previously presented separated)** The apparatus of claim 2, wherein the
2 overlapping region dielectric layers comprise portions of the substrate dielectric layers of the
3 members.

1 **9.(withdrawn and previously presented)** The apparatus of claim 1, further comprising:
2 a metal layer formed on an exposed portion of a dielectric layer or an external dielectric layer
3 formed on an exposed portion of a superconducting layer with a metal layer formed on the outer
4 surface of the external dielectric layer, where the metal layer forms a coupling or decoupling
5 capacitive element with a corresponding portion of the superconducting layer.

1 **10.(withdrawn and previously presented)** The apparatus of claim 9, further comprising:
2 a wire bonded to the metal layer, where the wire is adapted to link a plurality of the
3 apparatuses together to form an array or to connect the apparatus to a pre-amplifier.

1 **11.(withdrawn)** A hybrid MRI coil apparatus comprising:
2 two elongated superconducting legs, each leg including a superconducting layer,
3 two metal members, and
4 separating dielectric layers,
5 where the superconducting legs and the metal members are arranged to form a closed rectangular
6 shape having four overlapping regions formed where the legs overlap the metal members at opposite
7 faces of the metal members and where the separating dielectric layers are interposed between the
8 superconducting legs and the faces of the metal members to form built-in capacitors.

1 **12.(withdrawn)** The apparatus of claim 11, wherein each superconducting leg further includes
2 a substrate dielectric layer upon which the superconducting layer was formed.

1 **13.(withdrawn)** The apparatus of claim 12, wherein the substrate dielectric layer is rigid.

1 **14.(withdrawn)** The apparatus of claim 12, wherein the separating dielectric layers comprise
2 end portions of the substrate dielectric layers.

1 **15.(withdrawn)** The apparatus of claim 12, wherein the metal members comprise metal blocks
2 and the separating dielectric layers comprise end portions of the substrate dielectric layers.

1 **16.(withdrawn)** The apparatus of claim 12, wherein the metal members comprise metal blocks
2 and the separating dielectric layers comprise a separate dielectric layers from the substrate dielectric
3 layers.

1 **17.(withdrawn)** The apparatus of claim 11, wherein each metal member includes a portion
2 extending out past the legs and adapted to contact a metal ring.

1 **18.(withdrawn)** The apparatus of claim 11, wherein the metal blocks comprise protrusions
2 form an inner surface of a top metal ring or a bottom metal ring.

1 **19.(withdrawn and previously presented)** The apparatus of claim 11, further comprising:

2 a metal layer formed on an exposed portion of a dielectric layer or an external dielectric layer
3 formed on an exposed portion of a superconducting layer with a metal layer formed on the outer
4 surface of the external dielectric layer, where the metal layer forms a coupling or decoupling
5 capacitive element with a corresponding portion of the superconducting layer.

1 **20.(withdrawn)** The apparatus of claim 19, further comprising:

2 a wire bonded to the metal layer, where the wire is adapted to link a plurality of the
3 apparatuses together to form an array or to connect the apparatus to a pre-amplifier.

1 **21.(withdrawn and previously presented)** A birdcage-type resonator apparatus comprising:

2 a plurality of coils, each coil including:

3 four members, each member including a superconducting layer, where the members
4 are arranged to form four overlapping regions, where each overlapping region
5 comprises a capacitor formed from overlapping portions of the superconducting
6 layers of two of the members and an overlapping region dielectric layer interposed
7 therebetween, and

8 where two of the members are straight and two of the members are curvilinear to
9 form a closed saddle-shaped coil,

10 where the coils are arranged to form at least one small animal cavity to permit MRI
11 imaging of an animal placed within the cavity.

1 **22.(withdrawn and previously presented)** The apparatus of claim 21, wherein each member
2 further including a substrate dielectric layer upon which the superconducting layer was formed,
3 where the dielectric layer of the straight members comprise a rigid dielectric material and the
4 dielectric layer of the curvilinear members comprise a flexible dielectric material.

1 **23.(withdrawn and previously presented)** The apparatus of claim 21, wherein the superconducting
2 layer of the curvilinear members comprises a plurality of substantially flat superconducting
3 segments.

1 **24.(withdrawn and previously presented)** The apparatus of claim 23, wherein the overlapping

2 regions of the superconducting layer of the curvilinear member comprise portions of one of the
3 substantially flat superconducting segments.

1 **25.(withdrawn and previously presented)** The apparatus of claim 22, wherein the overlapping
2 region dielectric layers comprise separate dielectric layers distinct from the substrate dielectric
3 layers.

1 **26.(withdrawn and previously presented)** The apparatus of claim 25, wherein the substrate and
2 the overlapping region dielectrics are composed of the same or different dielectric material.

1 **27.(canceled)**

1 **28.(withdrawn and previously presented)** The apparatus of claim 21, wherein the overlapping
2 region dielectric layers comprise portions of the substrate dielectric layers of the members.

1 **29.(withdrawn and previously presented)** The apparatus of claim 21, further comprising:
2 a metal layer formed on an exposed portion of a dielectric layer or an external dielectric layer
3 formed on an exposed portion of a superconducting layer with a metal layer formed on the outer
4 surface of the external dielectric layer, where the metal layer forms a coupling or decoupling
5 capacitive element with a corresponding portion of the superconducting layer.

1 **30.(withdrawn and previously presented)** The apparatus of claim 29, further comprising:
2 a wire bonded to the metal layer, where the wire is adapted to link a plurality of the
3 apparatuses together to form an array or to connect the apparatus to a pre-amplifier.

1 **31.(withdrawn)** A birdcage-type resonator apparatus comprising:
2 a plurality of hybrid coils including:
3 two elongated superconducting legs, each leg including a superconducting layer,
4 two metal members, and
5 separating dielectric layers,
6 where the coils to form at least one small animal cavity to permit MRI imaging of an animal placed
7 within the cavity and where the superconducting legs and the metal members are arranged to form
8 a closed rectangular shape having four overlapping regions, where the legs overlap the metal member
9 at opposite faces thereof and where the separating dielectric layers are interposed between the
10 superconducting legs and the faces of the metal members to form built-in capacitors.

1 **32.(withdrawn)** The apparatus of claim 31, wherein each superconducting leg further includes
2 a substrate dielectric layer upon which the superconducting layer was formed.

1 **33.(withdrawn)** The apparatus of claim 32, wherein the substrate dielectric layer is rigid.

1 **34.(withdrawn)** The apparatus of claim 32, wherein the separating dielectric layers comprise
2 end portions of the substrate dielectric layers.

1 **35.(withdrawn)** The apparatus of claim 32, wherein the metal members comprise metal blocks
2 and the separating dielectric layers comprise end portions of the substrate dielectric layers.

1 **36.(withdrawn and currently amended)** The apparatus of claims 32, wherein the metal members
2 comprise metal blocks and the separating dielectric layers comprise a separate dielectric layers from
3 the substrate dielectric layers.

1 **37.(withdrawn and previously presented)** The apparatus of claim 31, wherein a top half of the
2 metal members comprise protrusions extending out from an inner surface of a top metal ring and a
3 bottom half of the metal members comprise protrusions extending out from an inner surface of a
4 bottom ring, where the two rings are adapted to cool the metal members and the legs.

1 **38.(withdrawn and previously presented)** The apparatus of claim 31, wherein the metal blocks
2 include a portion that extends out past the legs and the apparatus further include a top ring and a
3 bottom ring, where one portion of each coil is in contact with an inner surface of top ring and the
4 other portion of each coil is in contact with an inner surface of the bottom ring and where the two
5 rings are adapted to cool the metal members and the legs.

1 **39.(withdrawn and previously presented)** The apparatus of claim 31, further comprising:
2 a metal layer formed on an exposed portion of a dielectric layer or an external dielectric layer
3 formed form on an exposed portion of a superconducting layer with a metal layer formed on the
4 outer surface of the external dielectric layer, where the metal layer forms a coupling or decoupling
5 capacitive element with a corresponding portion of the superconducting layer.

1 **40.(withdrawn)** The apparatus of claim 39, further comprising:
2 a wire bonded to the metal layer, where the wire is adapted to link a plurality of the
3 apparatuses together to form an array or to connect the apparatus to a pre-amplifier.

1 **41.(canceled)**

1 **42.(withdrawn, previously presented)** A small animal MRI apparatus comprising:
2 a vacuum housing including at least one cylindrical cavity, where each cavity is configured
3 to receive a small animal,
4 a coolant reservoir including a coolant, a coolant inlet, a coolant outlet and a cold plate
5 forming an internal end of the reservoir,
6 a plurality of coils positioned within the housing to permit MRI imaging of an animal placed
7 in each one of the apertures, where the each coil comprises:
8 four members, each member including a superconducting layer, where the members
9 are arranged to form a closed flat rectangular shape having four overlapping regions,
10 and
11 separating dielectric layers interposed between the superconducting layers at the
12 overlapping regions to form built-in capacitors,
13 where each coil is in thermal contact with the cold plate and where each aperture has at least
14 three coils arranged in a triangular arrangement therearound.

1 **43.(canceled)**

1 **44.(withdrawn, currently amended)** The apparatus of claim 4542, wherein each coil
2 apparatus comprises:
3 two elongated superconducting legs, each leg including a superconducting layer,
4 two metal members, and
5 separating dielectric layers,
6 where the superconducting legs and the metal members are arranged to form the closed rectangular
7 shape having four overlapping regions formed where the legs overlap the metal members at opposite
8 faces of the metal members and where the separating dielectric layers are interposed between the
9 superconducting legs and the faces of the metal members to form built-in capacitors.

45.(canceled)

46.(canceled)

47.(canceled)

1 **48.(currently amended)** The apparatus of claim 4758, wherein each member further comprises:
2 a substrate dielectric layer upon which the superconducting layer was formed, where the
3 dielectric layer of the straight members comprise a rigid dielectric material and the dielectric layer

4 of the curvilinear members comprise a flexible dielectric material.

1 49.(currently amended) The apparatus of claim ~~46~~⁵⁸, wherein the superconducting layer of the
2 curvilinear members comprise a plurality of substantially flat superconducting segments.

1 50.(previously presented) The apparatus of claim 49, wherein the overlapping regions of the
2 superconducting layer of the curvilinear member comprise one of the substantially flat
3 superconducting segments.

1 51.(currently amended) The apparatus of claim ~~46~~⁵⁸, wherein the overlapping region dielectric
2 layers comprise separate dielectric layers distinct from the substrate dielectric layers.

1 52.(previously presented) The apparatus of claim 51, wherein the substrate and the overlapping
2 region dielectric layers are composed of the same or different dielectric material.

1 53.(currently amended) The apparatus of claim ~~46~~⁵⁸, wherein the overlapping region dielectric
2 layers comprise portions of the substrate dielectric layers of the members.

1 54.(currently amended) The apparatus of claim ~~45~~⁵⁸, wherein each coil apparatus includes:
2 a metal layer formed on an exposed portion of a dielectric layer or an external dielectric layer
3 formed on an exposed portion of a superconducting layer with a metal layer formed on the outer
4 surface of the external dielectric layer, where the metal layer forms a coupling or decoupling
5 capacitive element with a corresponding portion of the superconducting layer.

1 55.(previously presented) The apparatus of claim 54, each coil apparatus further includes:
2 a wire bonded to the metal layer, where the wire is adapted to link a plurality of the
3 apparatuses together to form an array or to connect the apparatus to a pre-amplifier.

1 56.(currently amended) The apparatus of claim ~~45~~⁵⁸, further comprising:
2 a plurality of spaced apart apertures, each configured to receive a small nonhuman animal
3 so that a plurality of animals can be MRI imaged simultaneously.

57.(canceled)

1 58.(new) An MRI apparatus capable of imaging small nonhuman animals comprising:
2 a vacuum housing including at least one aperture, where each aperture is configured to

3 receive a small nonhuman animal,
4 a coolant assembly including a coolant inlet, a coolant outlet and a cold plate, where a coolant
5 is adapted to cool the cold plate,
6 at least one resonator,
7 each resonator comprising two closed saddle-shaped coils in thermal contact with the
8 cold plate,
9 each saddle-shaped coil comprising four members,
10 each member including a superconducting layer,
11 where the members are arranged to form four overlapping regions,
12 each overlapping region comprises a capacitor formed from
13 overlapping portions of the superconducting layers of two of
14 the members and an overlapping region dielectric layer
15 interposed therebetween,
16 where two of the members are straight and two of the members are
17 curvilinear to form the closed saddle-shaped coils,
18 where a resonator surrounds each aperture,
19 where the apparatus is capable of simultaneously MRI imaging animals placed in the apertures.

1 59.(new) An MRI apparatus capable of simultaneously imaging at least two small nonhuman
2 animals comprising:
3 a vacuum housing including at least two single-sided, non-collinear apertures, each aperture
4 configured to receive a small nonhuman animal so that a plurality of animals can be imaged
5 simultaneously,
6 a coolant assembly including a coolant inlet, a coolant outlet and a cold plate, where a coolant
7 is adapted to cool the cold plate,
8 at least two resonators comprising:
9 a plurality of closed saddle-shaped coils in thermal contact with the cold plate and
10 arranged to form a cylindrical structure,
11 where a resonator surrounds each aperture, and
12 where the apparatus is capable of simultaneously MRI imaging animals placed in the apertures.

1 60.(new) The apparatus of claim 59, wherein the resonator comprises:
2 two closed saddle-shaped coils.

1 61.(new) The apparatus of claim 60, wherein each saddle-shaped coil comprises:
2 four members, each member including a superconducting layer, where the members are

3 arranged to form four overlapping regions, where each overlapping region comprises a capacitor
4 formed from overlapping portions of the superconducting layers of two of the members and an
5 overlapping region dielectric layer interposed therebetween,

6 where two of the members are straight and two of the members are curvilinear to form the
7 closed saddle-shaped coils.

1 **62.(new)** The apparatus of claim 61, wherein each member further comprises:

2 a substrate dielectric layer upon which the superconducting layer was formed, where the
3 dielectric layer of the straight members comprise a rigid dielectric material and the dielectric layer
4 of the curvilinear members comprise a flexible dielectric material.

1 **63.(new)** The apparatus of claim 61, wherein the superconducting layer of the curvilinear
2 members comprise a plurality of substantially flat superconducting segments.

1 **64.(new)** The apparatus of claim 63, wherein the overlapping regions of the superconducting
2 layer of the curvilinear member comprise one of the substantially flat superconducting segments.

1 **65.(new)** The apparatus of claim 61, wherein the overlapping region dielectric layers comprise
2 separate dielectric layers distinct from the substrate dielectric layers.

1 **66.(new)** The apparatus of claim 65, wherein the substrate and the overlapping region dielectric
2 layers are composed of the same or different dielectric material.

1 **67.(new)** The apparatus of claim 61, wherein the overlapping region dielectric layers comprise
2 portions of the substrate dielectric layers of the members.

1 **68.(new)** The apparatus of claim 61, wherein each coil apparatus includes:

2 a metal layer formed on an exposed portion of a dielectric layer or an external dielectric layer
3 formed on an exposed portion of a superconducting layer with a metal layer formed on the outer
4 surface of the external dielectric layer, where the metal layer forms a coupling or decoupling
5 capacitive element with a corresponding portion of the superconducting layer.

1 **69.(new)** The apparatus of claim 68, each coil apparatus further includes:

2 a wire bonded to the metal layer, where the wire is adapted to link a plurality of the
3 apparatuses together to form an array or to connect the apparatus to a pre-amplifier.

1 **70.(new)** An MRI apparatus capable of simultaneously imaging at least two small nonhuman
2 animals comprising:

3 a vacuum housing including a plurality of space apart apertures, each aperture configured to
4 receive an animal so that a plurality of animals can be imaged simultaneously,

5 a coolant assembly including a coolant inlet, a coolant outlet and a cold plate, where a coolant
6 is adapted to cool the cold plate,

7 at least two resonators comprising:

8 a plurality of closed saddle-shaped coils in thermal contact with the cold plate and
9 arranged to form a cylindrical structure,

10 where a resonator surrounds each aperture, and

11 where the apparatus is capable of simultaneously MRI imaging animals placed in the apertures.

1 **71.(new)** The apparatus of claim 70, wherein the resonator comprises:

2 two closed saddle-shaped coils.

1 **72.(new)** The apparatus of claim 70, wherein each saddle-shaped coil comprises:

2 four members, each member including a superconducting layer, where the members are
3 arranged to form four overlapping regions, where each overlapping region comprises a capacitor
4 formed from overlapping portions of the superconducting layers of two of the members and an
5 overlapping region dielectric layer interposed therebetween,

6 where two of the members are straight and two of the members are curvilinear to form the
7 closed saddle-shaped coils.

1 **73.(new)** The apparatus of claim 72, wherein each member further comprises:

2 a substrate dielectric layer upon which the superconducting layer was formed, where the
3 dielectric layer of the straight members comprise a rigid dielectric material and the dielectric layer
4 of the curvilinear members comprise a flexible dielectric material.

1 **74.(new)** The apparatus of claim 72, wherein the superconducting layer of the curvilinear
2 members comprise a plurality of substantially flat superconducting segments.

1 **75.(new)** The apparatus of claim 74, wherein the overlapping regions of the superconducting
2 layer of the curvilinear member comprise one of the substantially flat superconducting segments.

1 **76.(new)** The apparatus of claim 72, wherein the overlapping region dielectric layers comprise
2 separate dielectric layers distinct from the substrate dielectric layers.

1 **77.(new)** The apparatus of claim 76, wherein the substrate and the overlapping region dielectric
2 layers are composed of the same or different dielectric material.

1 **78.(new)** The apparatus of claim 72, wherein the overlapping region dielectric layers comprise
2 portions of the substrate dielectric layers of the members.

1 **79.(new)** The apparatus of claim 72, wherein each coil apparatus includes:
2 a metal layer formed on an exposed portion of a dielectric layer or an external dielectric layer
3 formed on an exposed portion of a superconducting layer with a metal layer formed on the outer
4 surface of the external dielectric layer, where the metal layer forms a coupling or decoupling
5 capacitive element with a corresponding portion of the superconducting layer.

1 **80.(new)** The apparatus of claim 79, each coil apparatus further includes:
2 a wire bonded to the metal layer, where the wire is adapted to link a plurality of the
3 apparatuses together to form an array or to connect the apparatus to a pre-amplifier.